

WHAT IS CLAIMED IS:

1. A method of manufacturing an optical element,
comprising the stages of:

machining a substrate;

5 removing a contamination from a surface of the
substrate after the machining; and

removing a deterioration layer in the surface of
the substrate after the machining.

10 2. A method according to claim 1, wherein the
substrate is made of CaF_2 single crystal.

15 3. A method according to claim 1, wherein the
contamination removing stage includes the stage of
focusing laser light on the surface of the substrate.

4. A method according to claim 3, wherein the
laser light is KrF excimer laser light.

20 5. A method according to claim 1, wherein the
deterioration layer removing stage includes a step of
ultrasonic-washing the surface of the substrate with an
aqueous wash solution.

25 6. A method according to claim 5, wherein in the
ultrasonic washing step, ultrasonic washing with a wash
solution containing a surface-active agent and

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ultrasonic washing with pure water are performed in succession.

5 7. A method according to claim 6, wherein the deterioration layer removing stage further includes a step of rinsing the substrate with pure water and a step of drying the rinsed substrate after the surface of the substrate is ultrasonic-washed with pure water.

10 8. A method according to claim 1, wherein the contamination removing stage includes the steps of:
immersing the substrate in acetone;
taking out the substrate from the acetone and then
wiping the surface thereof with a paper containing
15 diamond powder;
processing the wiped surface of the substrate with solvent; and
processing the surface-processed substrate with
UV/O3.

20 9. A method according to claim 8, wherein the solvent is ether.

25 10. A method according to claim 6, wherein the surface-active agent is an alkalescent surface-active agent.

11. A method according to claim 7, wherein the drying step is performed with a warm air.

12. A method according to claim 1, wherein the machining stage includes a step of cutting the substrate from a CaF_2 single crystalline base substrate and polishing the surface of the cut substrate with a predetermined surface shape.

13. A method according to claim 12, wherein the machining stage includes a step of forming a protective film on the polished surface of the substrate, and the contamination removing stage is performed after the protective film is removed from the surface of the substrate.

14. A method according to claim 1, wherein the contamination is one of abrasive, oil content, and other foreign matter.

15. A method according to claim 1, wherein a surface roughness of the optical element is 0.5 to 0.55 nm by an examination with an RMS.

16. A method according to claim 1, wherein the optical element is one of a lens, a prism, a transparent plate, and a transparent rod.

17. A method of manufacturing an optical element,
comprising the steps of:

machining a substrate; and

removing a deterioration layer in the surface of
5 the substrate after the machining.

18. An exposure apparatus comprising:

an optical system having an optical element
manufactured by the manufacturing method according to
10 any one of claims 1 to 17, for illuminating a wafer
with laser light having a wavelength of 200 nm or less.

19. A device manufacturing method comprising the
stages of: exposing the wafer by the exposure
15 apparatus according to claim 18; and developing the
exposed wafer.

20. An optical element washing machine including
an optical element holding unit, an excimer laser unit,
20 and a focal control unit for focusing excimer laser
light from the excimer laser unit, the optical element
holding unit having a holder, a rotation stage, and a
three dimensional control stage,

in which the holder is means for holding an
25 optical element,

the rotation stage is means for rotating the
holder,

the three dimensional control stage is a constitution element of position control means for causing the rotation stage to move in a vertical direction and/or a horizontal direction,

5 the excimer laser unit is a light source for
emitting ultraviolet radiation, and

the focal control unit has basic control value setting means for setting a basic control value for a focal matching state of the ultraviolet radiation from the excimer laser unit, focal matching determination means for determining a focal matching state of the excimer laser light, and correction means for sending a correction amount corresponding to a determination result of the focal matching determination means to the position control means.